GENERATION OF QUASI-PERPENDIQULARE COLLISIONLESS SHOCKS BY LASER-PRODUCED PLASMA TO SIMULATE THE EFFECTS OF SUPER-COMPRESSION OF THE EARTH MAGNETOSPHERE

Zakharov[1] Yu.P., Ponomarenko[1] A.G., Terekhin[2] V.A.,Golubev[2] A.I., Boyarintsev[1] E.L., Vchivkov[1] K.V., Melekhov[1] A.V., Posukh[1] V.G., Prokopov[1] P.A.

[1] *Institute of Laser Physics (ILP) Siberian Branch of Russian Academy of Sciences, Av. Lavrentyeva 13/3, 630090, Novosibirsk, Russia. E-mail: ki1z@mail.ru*

[2] *All-Russian Research Institute of Experimental Physics (VNIIEF), Av. Mira 37, 607188, Sarov, Russia.*

Giant plasma releases of so called Coronal Mass Ejections (CME, with kinetic energy up to $E_k \sim 10^{36}$ эрг) from the surface of the Sun and their potential catastrophical impact onto Earth's magnetosphere, with the probable opportunity to compress it 2, 3 or more times [1-3], represent one of the most important problem in the geophysical and historically-bioevolutional investigations of the past and present of the Earth. It was supposed that the re-connection of magnetic fields at MagnetoPause (MP) could play [2] an exclusive role in the inward shift of MP, but from the more general point of view (to perform laboratory simulation [1] of MP dynamics), the most important and common features of CME propagation in Solar Wind plasma are the formation of Quasi-Perpendiculare Shocks (Q-PS) ahead of Super-Alfvenic CME. It is provided by the almost radial (along to **R**) motion of CME from the Sun, while the Interplanetary Magnetic Field $\mathbf{B_0}$ has an angle $\theta \sim 45^0$ (relative to **R**) near the Earth orbit. Up to date, in spite of intensive development of laser energetics and energy [4] of Laser-Produced Plasma (LPP, e.g. in comparison with initial simulations [5] at KI-1 facility of ILP), such collisionless Q-PS never were studied in laboratory [6], excluding recent LPP-experiment (see Fig. 1) at KI-1 [7]. In the given work, a first results of our study were presented together with relevant calculations by hybrid codes and the data of physical model of VNIIEF [8] on the collisionless Magnetic Laminar Interaction of spherical LPP with magnetized background plasma. A special analysis was done on the conditions of whistler generation in front of oblique shocks. This work was supported by ILP SB RAS Research Program 0307-2016-0002 and by Fundamental Program of Presidium RAS/Siberian Branch of RAS on 2017.

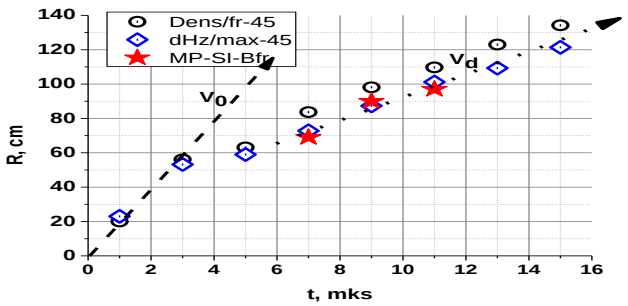

Fig. 1. R-t diagram propagation of strong disturbances in experiment **MP-SI** along to line target-dipole (at angle $\theta \sim 45^0$ to $\mathbf{B_{0z}}$), according to data: registration of front magnetic disturbances (asterisk) and data of hybrid code (on density front – circles and on maximum B_z-field – squares).

1. Yu.P. Zakharov, A.G. Ponomarenko, V.G. Posukh et al. *J. Phys.: Conf. Ser.* **688**, (2016) 012129.
2. V.S. Airapetian, et al., *Proc. 18th Workshop "Cool Stars, Stellar Systems…"* (2015) 257.
3. V.S. Airapetian, A. Glocer, G. Gronoff, et al., *Nature – Geoscience* **9**, (23 May 2016) 452.
4. Yu.P. Zakharov, A.G. Ponomarenko, V.A. Terekhin, et al. *Quantum Electronics* **46**, (2016) 399.
5. В. М. Антонов, Ю. П. Захаров, А.М. Оришич, и др. //*VII Всесоюз. Конф.* (Т. **III**) *по Физике Низкотемпературн. Плазмы, Ташкент, 1987 г:* Обз. Докл. – ИВТ АН СССР, 1988. – С.116.
6. D.B. Schaeffer, E.T. Everson, A.S. Bondarenko, et al., *Phys. Plasmas* **21** (2014) 056312.
7. Yu.P. Zakharov, A.G. Ponomarenko, B.A. Терехин, et al., *VII Intern. Symp. "Modern Problems of Laser Physics" (22-28 August 2016, Novosibirsk, ILP)* 254.
8. В.П. Башурин, А. И. Голубев, В.А. Терехин//*Журн. Прикл. Мех.Техн.Физ.* №5 (1983) –С.10.